CARDI Soil and Water Science
Technical Note No. 06

Kompong Siem calcareous phase

A new phase for the Kompong Siem Soil group of the Cambodian Agronomic Soil Classification

Only the Rice Soils of Cambodia have been described in detail (White et al. 1997). The naming and identification of the rice soil groups has become familiar to agronomists, extension officers and farmers in Cambodia due to their common usage and many training programmes conducted on their identification and properties (Heer et al. 1999). However, the Rice Soil Manual does not describe all the soils of Cambodia (White et al. 1997). The key for identification of rice soils allows for undefined and unclassified soils. Most of the upland soils of Cambodia are likely to fall into this category. Increased interest in crop diversification and upland farming has created a need for more detailed information on the soils in these areas. This is one of a series of Notes describing new soil groups or new phases of existing groups that are proposed for inclusion into the Cambodian Agronomic Soil Classification (CASC). A new phase of Kompong Siem Soil Group has been recognised and described by the CARDI Soil and Water Research program under the ACIAR Project, "Assessing land suitability for crop diversification in Cambodia and Australia". The purpose of this note is to assist agronomists, extension officers and farmers to recognise a new calcareous phase of the Kompong Siem Soil group, to outline its main limiting factors, soil management requirements, and potential for land use.

It is important to note that for upland soils, profile descriptions will need to be deeper than the upper 50 cm that is mostly used for rice soils, because of the greater root depth of field crops on upland soils, and their greater reliance on sub-soil stored water and nutrients.

This Research Note describes the appearance and properties of the calcareous phase of the Kompong Siem Soil group to help in its recognition in the field and to guide management for improved productivity. A more detailed explanation of its taxonomy, pedogenesis and soil chemical properties can be found in Hin et al. (2005).

Group Concept

The Soil Group concept has already been defined by White et al. (1997). It already allows for Kompong Siem soils formed on calcareous parent materials. The group concept of Kompong Siem is as follows:

"Soils on which stones or boulders of basalt or calcimorphic limestone are clearly visible in the profile or on the soil surface and which have a black or dark grey, clayey textured topsoil, which forms deep cracks over a clayey textured sub-soil." (from White et al. 1997).

It is proposed to recognise the Kompong Siem soils formed on calcareous parent material as a new phase largely because their alkalinity requires different management for crops apart from padi rice. The calcareous phase also extends the group concept to include soils on slopes that are unsuited to rice. Modification of the Key in White et al. (1997) will necessary to allow for the identification of the new Calcareous phase on flat and undulating land and additions are needed to the Key for identification of the Kompong Siem calcareous phase on sloping land on the sides of hills and mountains.

Occurrence

The calcareous phase of the Kompong Siem Soil group is associated with limestone hills of western Cambodia. It is well developed in Battambang province. The limestone hills are usually fairly rugged and dominated by rock outcrop (Fig. 1). The colluvial slopes within about 500 m of the limestone hills have structured grey clays over nodular carbonates at less than 1 metre. Further from the hills the dark clays are deeper, and carbonate nodules[1] start much deeper, usually below 1 metre. The most detailed observations of this soil have been in Banan district, Battambang, but its prevalence elsewhere has not been adequately described.

In Battambang, soils resembling the Kompong Siem Soil group occur on slopes of hills and therefore do not key out as Kompong Siem in the Cambodia Agronomic Soil Classification (White et al. 1997). They vary significantly in a number of properties for non-rice crops from those that occur on colluvium and alluvium from basalt in Kampong Cham Province, and hence have been made into a new phase of the Kompong Siem Soil group.

Detailed soil profiles for this soil have been made at the following locations and the full profile description plus soil analysis results are available from the Cambodia Soil database located at CARDI.

Site code	Eastings	Northings
ACIAR0031	288761	1445515
ACIAR0032	287213	1446779
ACIAR0033	285603	1450277
ACIAR0064		

Note: Datum IND60 Zone 48

General Description

The Kompong Siem calcareous phase is a very dark grey coloured soil with a high proportion of carbonate nodules. It is derived from weathering of limestone and is commonly found on mid to lower slopes of the rugged limestone hills (Fig. 1), as well on the alluvial plains associated with these hills. Its colour and texture should lead to

[1] Calcareous nodules are hard or soft, white to pale grey coloured rounded segregations (White et al. 1997, p. 69). They can vary in size from sand to gravel and stones (< 2- 6 mm). They are predominantly comprised of calcium carbonate, which can be confirmed by the effervescence (fizzing or bubbling reaction) developed when a drop of dilute hydrochloric acid (1 N) is placed on it.

identification as the Kompong Siem Soil group in CASC (White et al. 1997). However, on hill slopes, Kompong Siem calcareous phase is not suited to rice.

The profile is shallow (45 cm) to moderately deep (> 1 metre). The surface horizon is 24 to 30 cm deep, very dark grey to dark greyish brown, clayey texture, with few fine carbonate nodules. The surface is hard to very hard when dry.

The sub-surface layers are very dark grey to dark grey, extend to 45 cm depth or more, have clay texture, and are characterised by many fine carbonate nodules (Fig. 2). At 45 to 110 cm depth or greater, the soil lies on weathered light grey weathered limestone.

Profile description (See Fig. 2)

Surface

Depth	24 to 30 cm
Texture	Clay
Color	Very dark grey to black (moist)
Mottles	Nil
Consistency	Hard when dry
Structure	Variable

Sub soil

Thickness	15-35 cm
Texture	Clay
Color	Dark grey to dark greyish brown (moist)
Mottles	Nil
Consistency	Firm to extremely hard
Structure	Variable

B horizon

Thickness	0-70 cm
Texture	clay
Color	Dark grey to dark greyish brown (moist)
Mottles	Nil
Consistency	Firm
Structure	Variable

Synonyms

Hypercalcic Chernozem or Haplic Vertisol (FAO-ISRIC-ISSS 1998). In the Croker (1962) classification, this soil group would be classified as a Regur or Basic Lithosol, depending on the depth of the soil profile.

Soil management

Kompong Siem calcareous phase drains rapidly through cracks when dry so the first rains may not wet up the profile evenly, and leaching may occur at this time. The surface is usually hard when dry but sticky when wet. It is difficult to till to produce a suitable seedbed for non-rice crops. After the profile has wet up, it is prone to waterlogging due to poor internal drainage. Crops on the shallow forms of this soil (45 cm to weathered limestone) may also be prone to drought. On the deeper profiles

(110 cm), soil water storage will be high. The high clay content may limit plant availability of stored water if only light showers of rain occur, and soaking rains may be necessary for reliable early wet season crop establishment. Water erosion risk is low due to the stable soil structure except on steeper slopes.

Fertility Capability Class

Analysis conducted on a limited number of samples indicate that the profiles are slightly alkaline in the surface horizons, rising to moderately alkaline at depth. Severe chlorosis (yellowing of young leaves) indicating Fe deficiency is commonly observed on a range of crops growing on this soil (e.g. peanut, see Fig. 3). DTPA-extractable Fe levels were also low, and DPTA Mn was lower than other profiles in Banan district and elsewhere in Cambodia. Electrical conductivity values (1:5 extract) were > 0.5 mS/cm below 30 depth in one profile sampled indicating significant levels of soluble salts. This same soil profile also contained high exchangeable Na levels and moderate alkalinity.

Kompong Siem calcareous phase profiles contained low bicarbonate extractable P. Extractable S levels were variable from low to high. Exchangeable K was moderate in the surface soil layer, but dropped to low in sub-soils. DTPA Zn varied from moderate to low, with the lower values in sub-soils. Very low sub-soil B levels were obtained in one profile, otherwise moderate to low levels of B were extracted from the calcareous phase of Kompong Siem profiles.

The Fertility Capability Classification (Sanchez et al. 2003) of the soil is $CCr^{+}dhns^{-}v$, indicating a uniformly clayey soil to 50 cm depth with limestone gravels and seasonal dryness of the profile for > 60 days per year, free calcium carbonate, abundance of cracking clays, and incipient salinity and sodicity in the sub-soil.

Land capability

The Kompong Siem calcareous phase on hillslopes is not suited for paddy rice unless the fields were terraced. Overall capability for other field crops is low. Crop yields on this soil are generally inferior to those on the basaltic phases of Kompong Siem, and on Kien Svay and Toul Samroung Soil groups in Banan district. Alkaline tolerant crops like maize and soybean are favoured over peanut, mung beans and sesame. However, for each of these species, efficient cultivars could be selected to achieve higher yield on this soil by overcoming Fe deficiency.

Fig 1. Typical landscape of limestone hills (background) in Banan district, Battambang province with Kompong Siem Soil group, calcareous phase on the mid to lower slopes (foreground).

Fig 2. Typical soil profile for Kompong Siem Soil group, calcareous phase showing weathered limestone at the base of the profile.

Fig. 3. Iron chlorosis symptoms (yellowing of young leaves) in peanut on Kompong Siem calcareous phase soil, Banan district, Battambang province.

References

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